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# SnowEx: a NASA airborne campaign leading to a snow satellite mission

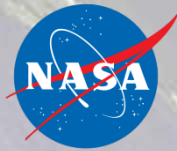
SnowEx update: Aug 4, 2016

**SnowEx Team/contributors to this report:** Edward Kim, Charles Gatebe, Amy Misakonis, Dorothy Hall, HP Marshall, Ludovic Brucker, Kelly Elder, Chris Heimstra

**Sponsored by NASA Headquarters/Terrestrial Hydrology Program Manager:** Jared Entin

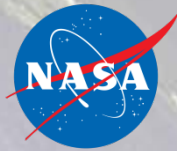
# Outline

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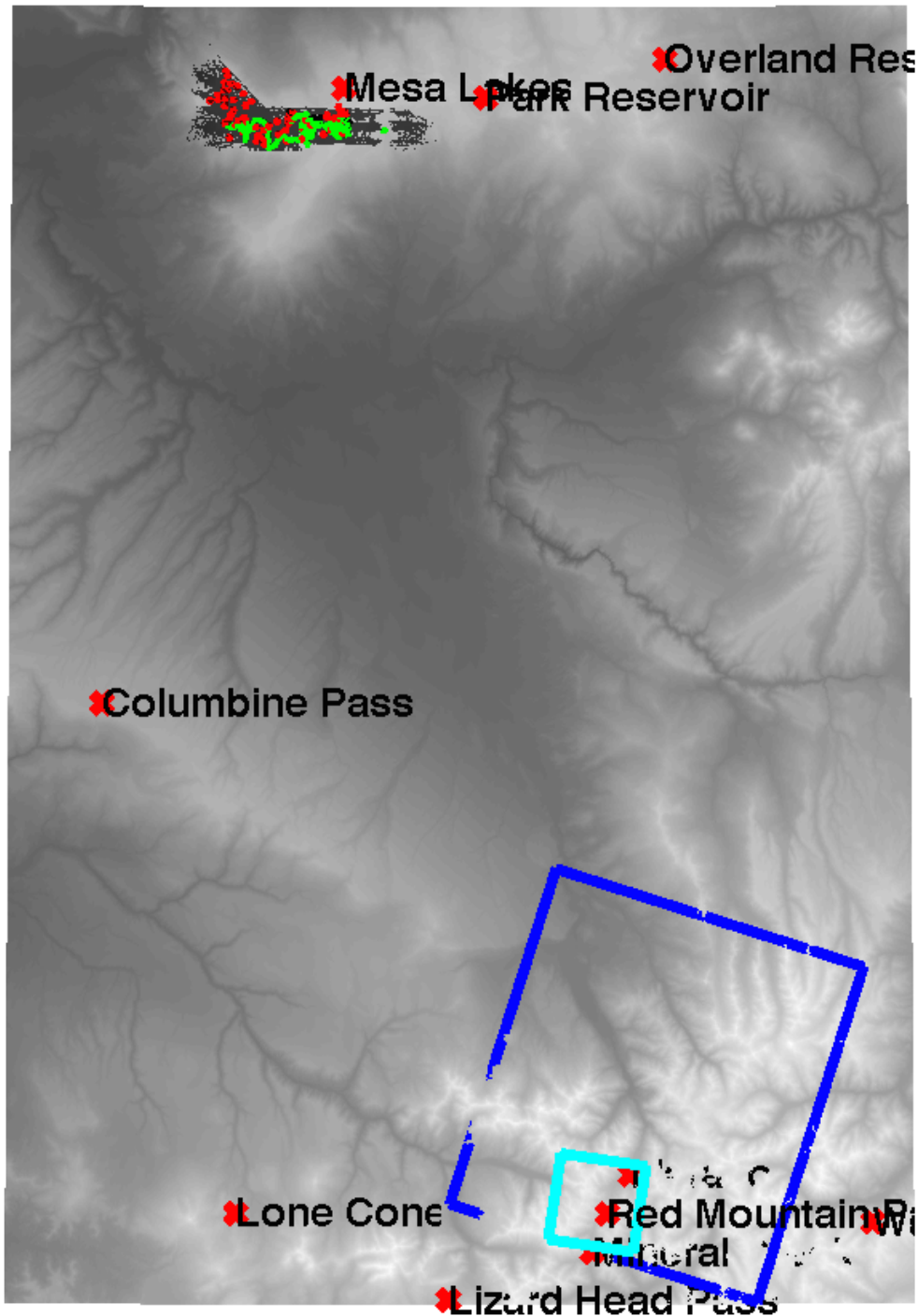
- Welcome — Ed Kim/C. Gatebe (3 min)
- Ground plans — HP Marshall (10 min)
- Airborne plans — Ed Kim (2min)
- Schedule & Logistics — Amy Misakonis (10 min)
- Updates from HQ — Jared Entin (5--10 min)
- Q&A — (10 min)

For more information, see [snow.nasa.gov](http://snow.nasa.gov)



# Ground truth/ Ground Based Remote Sensing update

HP Marshall



# SnowEx Year 1 Field Campaigns:

Grand Mesa and Senator Beck Basin, Colorado

***Snow-free:*** September 26-October 4, 2016

***Snow-on:*** February 6-26, 2016

Kelly Elder  
Ludo Brucker  
Chris Hiemstra  
H.P. Marshall

# Participation Survey Results

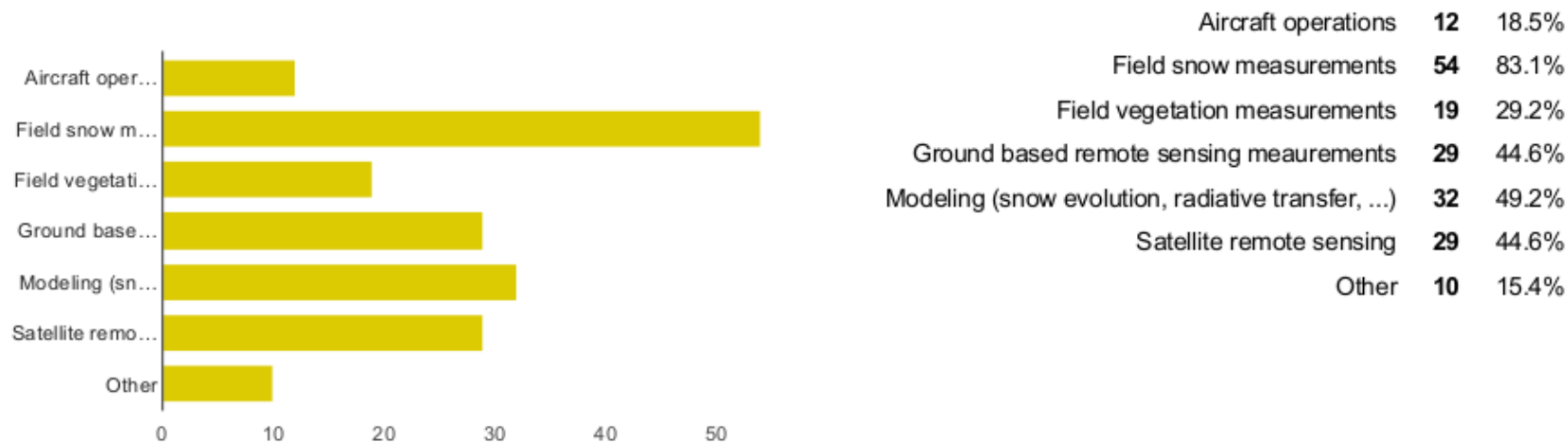
*65 entries representing 165 people  
(including 74 students, 45%)*

## Do you anticipate to contribute to



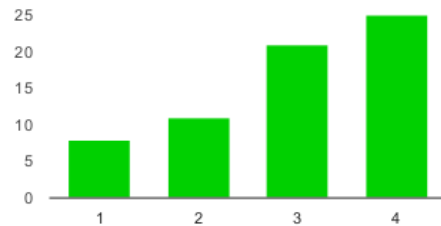
The core SnowEx measurements that will be guided by the experimental plan	61	93.8%
Your own set of experiments	25	38.5%

## Will your participation be in the area of



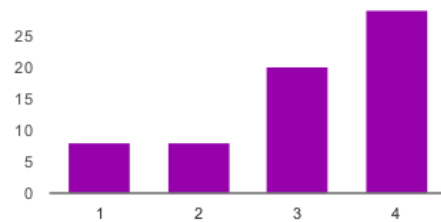
# Participation Survey Results: *experience*

## Snow Measurements



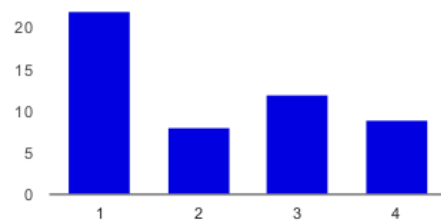
New: 1	8	12.3%
2	11	16.9%
3	21	32.3%
Expert: 4	25	38.5%

## Skis or snow shoes



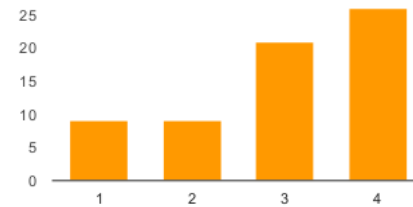
New: 1	8	12.3%
2	8	12.3%
3	20	30.8%
Expert: 4	29	44.6%

## Avalanche Training



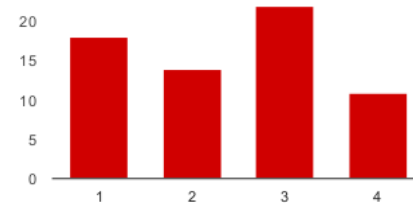
New: 1	22	43.1%
2	8	15.7%
3	12	23.5%
Expert: 4	9	17.6%

## Cold weather operations and survival



New: 1	9	13.8%
2	9	13.8%
3	21	32.3%
Expert: 4	26	40%

## Medical, CPR, or Wilderness First Aid

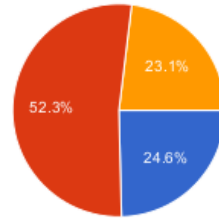


New: 1	18	27.7%
2	14	21.5%
3	22	33.8%
Expert: 4	11	16.9%

# Participation Survey Results:

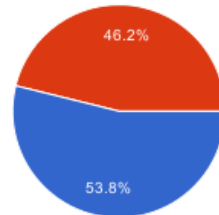
## *funding and fall campaign interest*

Can you cover travel costs?



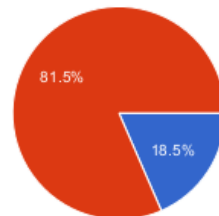
Yes	16	24.6%
I can contribute, but cannot cover everything	34	52.3%
No	15	23.1%

A small field work campaign is expected to occur in September/October 2016. Would you be interested?



Yes	35	53.8%
No	30	46.2%

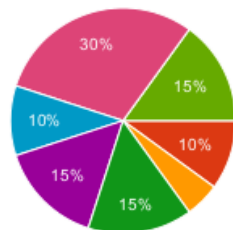
Do you have tower-mounted sensors or field-deployed equipment that need to be installed in September/October?



Yes	12	18.5%
No	53	81.5%

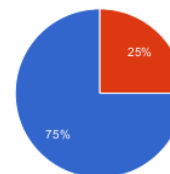
# Ground Based Remote Sensing Survey Results: *20 responses*

## Main remote sensing category



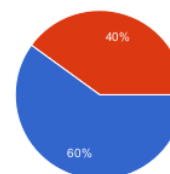
Accoustic	0	0%
Camera	2	10%
GPS	1	5%
Lidar	3	15%
Microwave radiometer	3	15%
Radar	2	10%
Spectrometer	6	30%
Other	3	15%

## Is your sensor available from October 2016 to late May 2017?



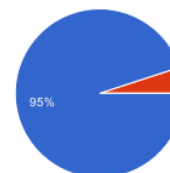
Yes	15	75%
No	5	25%

## Are you ready now to commit your sensor to SnowEx from October 2016 to late May 2017?



Yes	12	60%
No	8	40%

## Is your sensor available in February 2017?



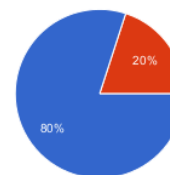
Yes	19	95%
No	1	5%

## Where are you scientifically interested to have your sensor operating?



LSOS - Grand Mesa	13	65%
LSOS - Senator Beck	9	45%
IOP - Grand Mesa	16	80%
IOP - Senator Beck	12	60%

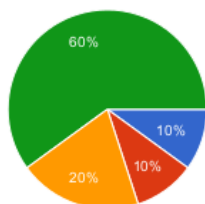
## Are you ready now to commit your sensor to SnowEx in February 2017?



Yes	16	80%
No	4	20%

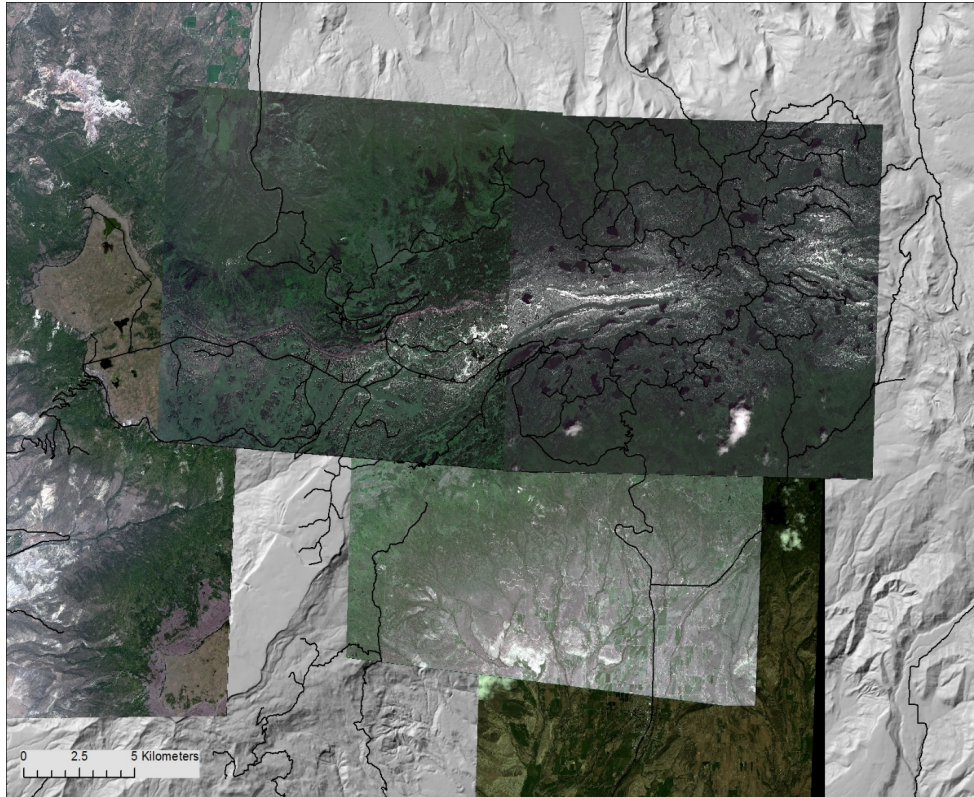
## Sensor technical readiness and availability

### Readiness Level

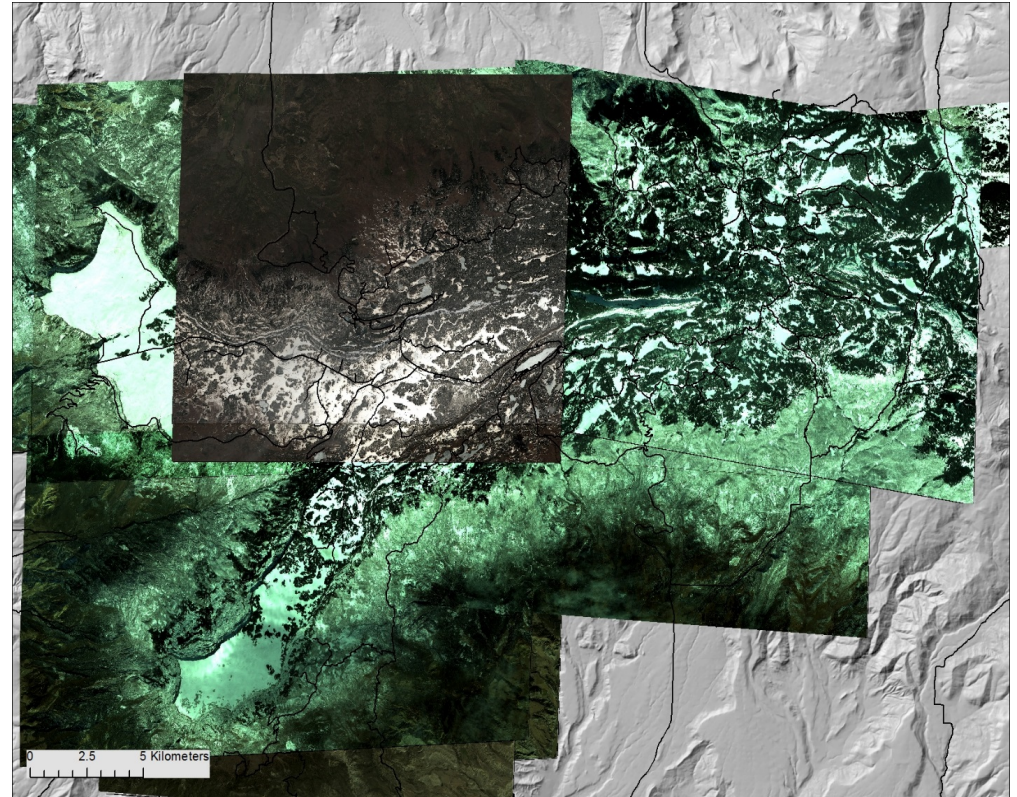


Prototype (SnowEx may recommend the geek meetup at the end of the IOP)	2	10%
Already operated during winter time, but not reliable yet (SnowEx may recommend IOP or geek meetup, not LSOS)	2	10%
Rather confident about the sensor ability to perform	4	20%
Reliable	12	60%

# Compiling available data, developing sampling strategy, input encouraged!



Summer WorldView2 mosaic,  
Grand Mesa, Colorado



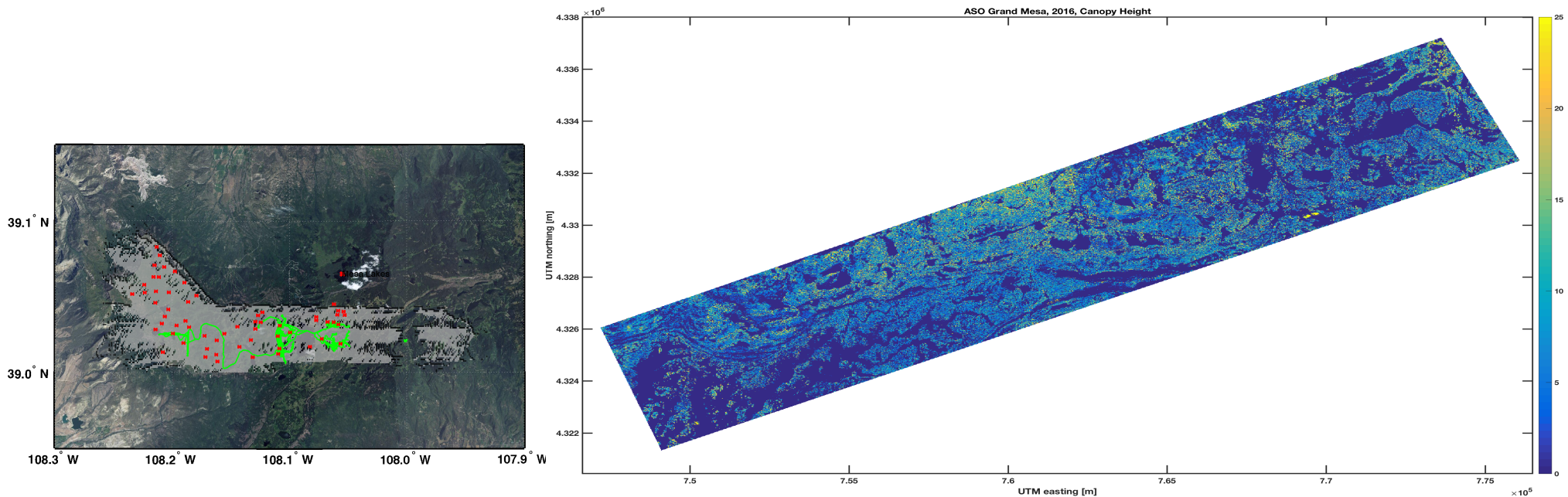
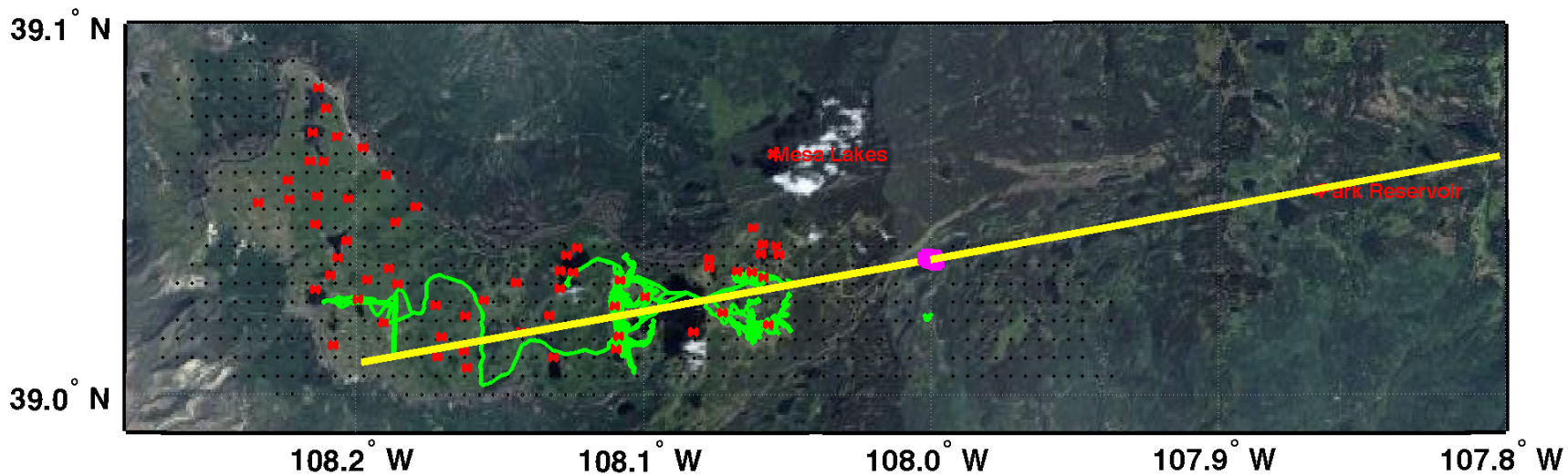
Winter WorldView2 mosaic, Grand  
Mesa, Colorado

# Previous Grand Mesa NASA Airborne Campaigns:

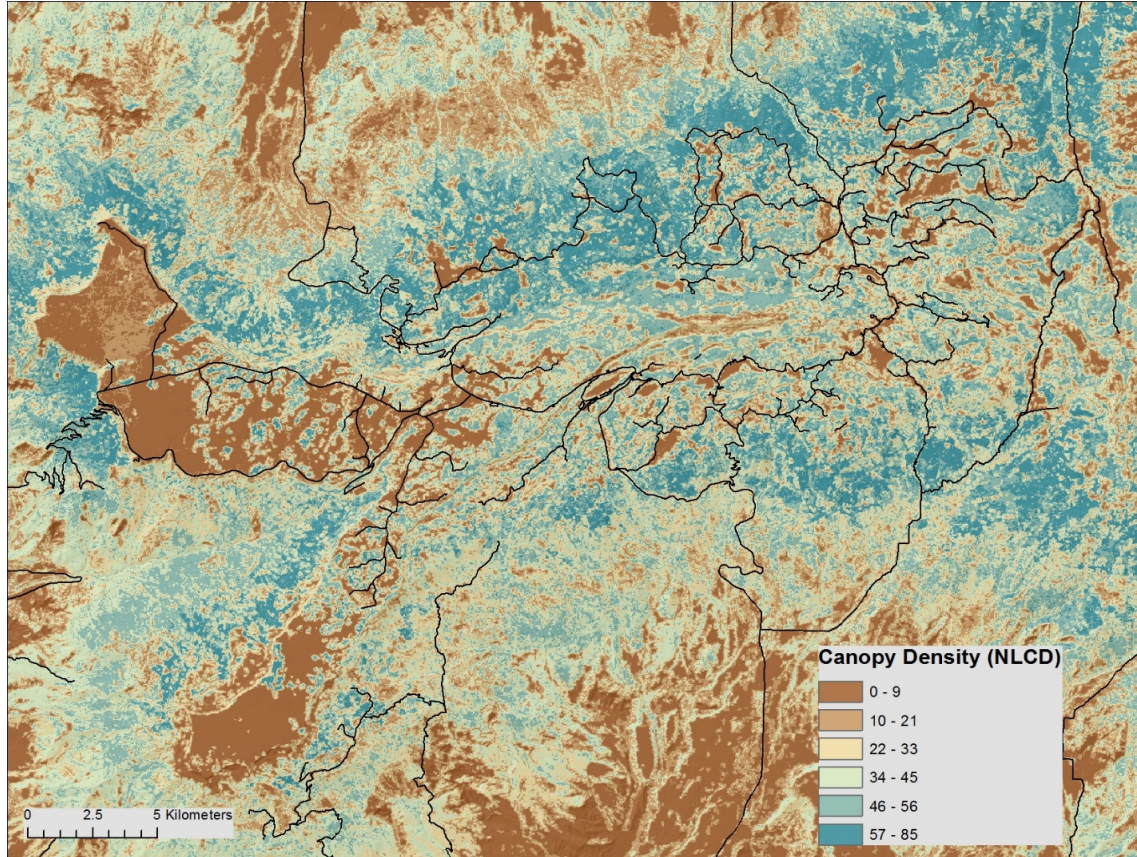
PolSCAT (Ku-band radar), CLPX-II, 2010-11

ASO (LiDAR), 2014-2016

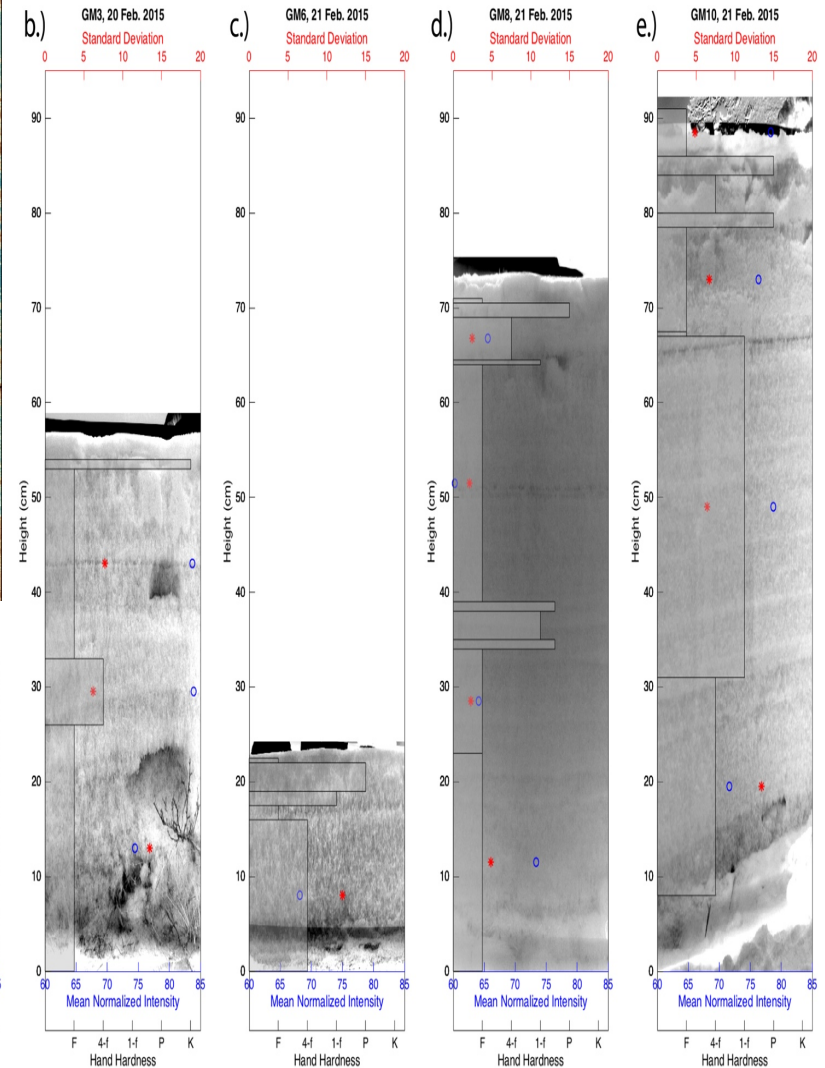
WISM (radar,radiometer,LiDAR), 2015-2016



# Grand Mesa, Colorado



Sampling strategy will focus on capturing dynamic range in both SWE and vegetation/forest metrics.



# LSOS Site Overview



# GROOMED SKI TRAIL



# JUMBO 2 751530 E, 432690 N, 12 S



Fir 9-22 m  
Spruce 20-22 m

# JUMBO 11

751425 E, 4326848 N, 12 S

Aspen 6-8 m

Fir 6-15m

Open ground



# RANGER STATION

TRUCK?

SHOP

TRUCK?

LODGE

LODGE

SNOW PITS?

+8° TO SOUTHERN HORIZON

MET STATION?

© 2016 Google

Google earth

128 ft

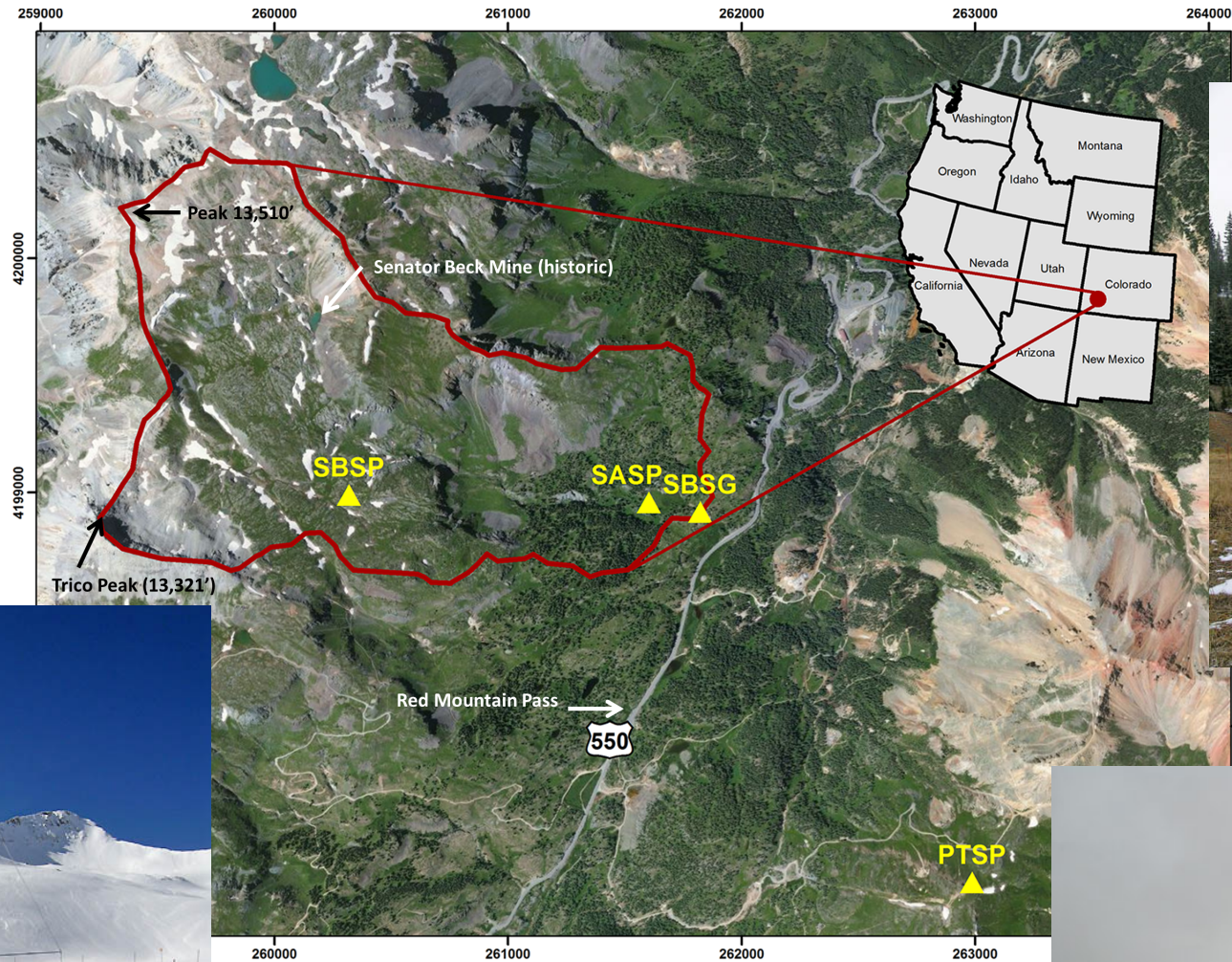
1993

Imagery Date: 6/4/2014

12 S 751090.47 m E 4326603.39 m N elev 9781 ft

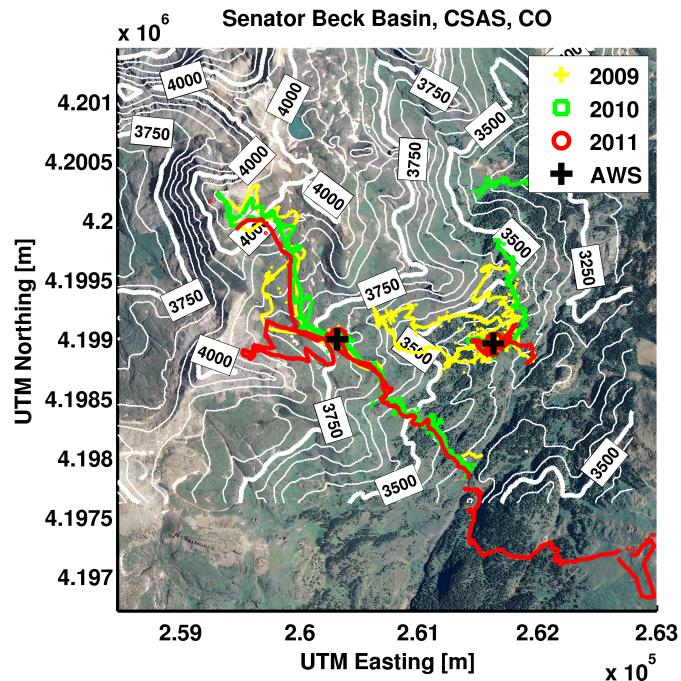
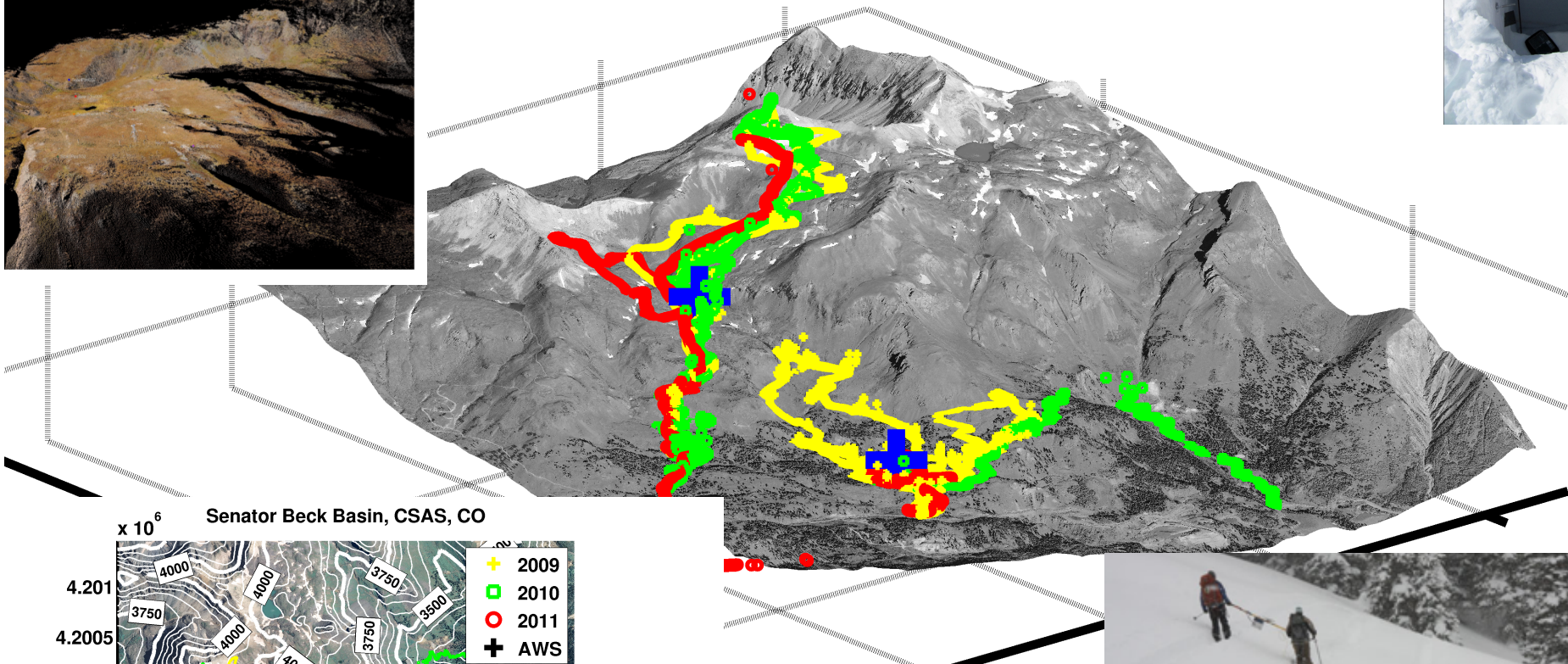
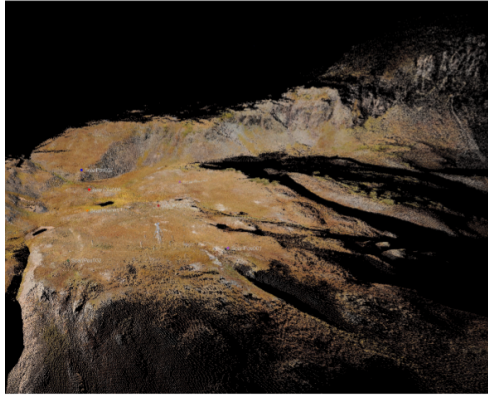
eye alt 10350 ft

# Senator Beck Basin, Colorado



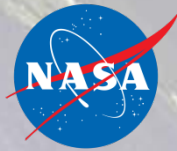
Center for Snow and Avalanche Studies  
<http://www.snowstudies.org/>

# Senator Beck Basin, CSAS, CO



# Sampling Strategy Under Construction

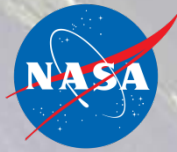
- We want your input!
- Participation survey
- Ground based remote sensing survey
- Follow-up detailed survey – please complete!
- <https://goo.gl/forms/udJ6GZNudEq5oF342>
- Available remote sensing, ground-based, modeling data is being compiled to inform sample design



# **SnowEx aircraft & instrument update**

E.Kim

# Aircraft & Instruments for Each Deployment

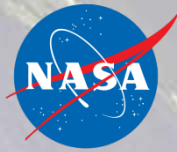


- Fall 2016:
  - ASO on its aircraft
    - Lidar (1064 nm; 3.5 km/1m @ 3 km alt.)
    - Hyperspectral (350-1050 nm;  $\pm 34^\circ$ )
- Winter 2017:
  - NRL P-3
    - SAR (SnowSAR; X and Ku band polarimetric imaging radar, ~5m spatial resolution)
    - Passive microwave (AESMIR; 10, 19 and 37 GHz; H and V; 200 m @ 600 m alt.)
    - BRDF (CAR) (multispectral: 340-2300 nm; iFOV:  $1^\circ$ /FOV:  $180^\circ$ )
    - Thermal IR (TBD)
  - ASO on its aircraft
    - Lidar
    - Hyperspectral
- Summer 2017 (SAR (SnowSAR); aircraft TBD)

NO CHANGE

# Next steps

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- Fleshing out detailed experiment plans for each instrument.
  - Closely coordinated w/ground truth and GBRS
- Identifying airport to be used by P-3 & associated logistics/communications w/ground efforts.

**NO CHANGE**

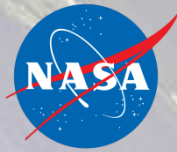


# **SCHEDULE STATUS AND RISKS**

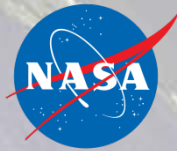
Amy Misakonis

# SnowEx Major Milestones

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- 3<sup>rd</sup> survey due -- 8/11/16
- Panel convenes -- 8/12/16
- Decisions announced -- 8/15/16
- Fall Deployment – 9/25/16 – 10/4/16
  - Ground Truth
  - ASO
- Instruments on Deck @ Aircraft Facility – 12/15/16
- Test Flight – 1/26/17 – 1/30/17
- Winter Deployment
  - Early GT Arrival – 2/1/17
  - Aircraft and GT Campaign – 2/6/17 – 2/24/17
- Final Data Delivery from all Instruments – 6/30/17



# Update from HQ

Jared Entin